2019

Organic Spring Barley Variety Trial

Heather Darby

Hillary Emick

Haley Jean

NORTHWEST CROPS & SOILS PROGRAM

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Dr. Heather Darby, UVM Extension Agronomist
Hillary Emick and Haley Jean
UVM Extension Crop and Soil Technicians
(802) 524-6501

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THE UNIVERSITY OF VERMONT EXTENSION

2019 ORGANIC SPRING BARLEY VARIETY TRIAL

Dr. Heather Darby, University of Vermont Extension
heather.darby[at]uvm.edu

With the revival of the small grains industry in the Northeast and the strength of the locavore movement, craft breweries and distilleries have expressed an interest in sourcing local barley for malting. Malting barley must meet specific quality characteristics such as low protein content and high germination. Depending on the variety, barley can be planted in either the spring or fall, and both two- and six-row barley can be used for malting. In 2019, UVM Extension in collaboration with the Eastern Spring Malting Barley Nursery (ESBN) testing network, conducted a spring malting barley trial to evaluate yield and quality of 28 varieties. Some varieties that had not performed well or are no longer commercially available, were dropped from the trial and new varieties were added.

MATERIALS AND METHODS

The spring barley variety trial was located at Borderview Research Farm in Alburgh, VT. The experimental plot design was a randomized complete block with three replications. The treatments were twenty-eight spring malting barley varieties, listed in Table 1.

Table 1. Twenty-eight spring barley varieties trialed at Borderview Research Farm in Alburgh, VT, 2019.

Spring barley variety	Type	Seed source
2ND32529	2-row	North Dakota State University
2ND34634	2-row	North Dakota State University
2ND34954	2-row	North Dakota State University
2ND35530	2-row	North Dakota State University
2ND35693	2-row	North Dakota State University
80675-52	2-row	Secobra (France)
AAC Connect	2-row	Meridian Seeds
AAC Synergy	2-row	Agriculture and Agri-Food Canada (Brandon)
Accordine	2-row	Ackermann (Germany)
CDC Fraser	2-row	Semican
Champion	2-row	Semican
Crescendo	2-row	Secobra (France)
Esma	2-row	Secobra (France)
Explorer	2-row	Ackerman, Germany
Fangio	2-row	Secobra (France)
Iconic	2-row	Secobra (France)
Klarinette	2-row	Secobra (France)
KWS Amadora	2-row	KWS Cereals USA LLC, Germany
KWS Fantex	2-row	KWS Cereals USA LLC, Germany
KWS Tinka	2-row	KWS Cereals USA LLC, Germany
LCS Genie	2-row	Limagrain Cereal Seeds
LCS Odyssey	2-row	Limagrain Cereal Seeds

ND Genesis	2-row	North Dakota State University
Newdale	2-row	Agriculture and Agri-Food Canada
Pinnacle	2-row	North Dakota State University
Rafale	2-row	Semican
Sangria	2-row	Ackerman, Germany
Tradition	6-row	Busch Agricultural Resources, LLC

All plots were managed with practices similar to those used by producers in the surrounding areas (Table 2). The previous crop planted at the site was soybeans. In April, the trial area was plowed, disked and spike tooth harrowed to prepare for planting. The plots were seeded with a Great Plains NT60 Cone Seeder at a seeding rate of 350 live seeds m^{-2} into a Benson rocky silt loam. Most varieties were planted on 30-Apr. The varieties Champion, CDC Fraser, and Rafale were planted on 6-May. Plot size was 5' x 20'.

Table 2. Agronomic and trial information for spring barley variety trial, 2019.

Trial Information	Borderview Research Farm Alburgh, VT
Soil type	Benson rocky silt loam
Previous crop	Soybeans
Tillage operations	Spring plow, disc, and spike tooth
Harvest area (ft)	5 x 20
Row spacing (in)	6
Seeding rate (live seeds m^{-2})	350
Replicates	3
Planting date	30-Apr & 6-May
Harvest date	29-Jul

On 20-Jun, plots were scouted for disease and insect pests. Three plants from each plot were examined. The top two leaves were examined and evaluated for the presence of disease and insect damage. The Clive James, 'An Illustrated Series of Assessment Keys for Plant Diseases, Their Preparation and Usage' was used to identify and determine the severity of plant disease infection. Damage recorded as a percent of the leaf surface that was affected by pest or disease. When the barley reached the soft dough growth stage (10-Jul), Fusarium Head Blight (FHB) intensity was assessed by randomly clipping 60-100 heads from each plot, counting spikes, and visually assessing each head for FHB infection. The infection rate was assessed by using the North Dakota State University Extension Service's "A Visual Scale to Estimate Severity of *Fusarium* Head Blight in Wheat" online publication.

Barley heights and lodging were recorded prior to harvest on 29-Jul. Heights were measured, excluding awns, in centimeters for three plants in each plot, and lodging was rated on a 0 to 9 scale for the whole plot; 0 indicated no lodging and 9 meant the plot was completely lodged and could not be harvested. On 29-Jul, the plots were harvested using an Almaco SPC50 small plot combine.

Following the harvest of spring barley, seed was cleaned with a small Clipper cleaner (A.T. Ferrell, Bluffton, IN). Quality measurements included standard testing parameters used by commercial malt houses. Plot yield was weighed. Harvest moisture was determined for each plot using a DICKEY-john Mini GAC moisture and test weight meter. Generally the heavier the barley is per bushel, the higher malting quality. A one-pound subsample was collected to determine quality. The samples were then ground into flour using the Perten LM3100 Laboratory Mill, and were evaluated for crude protein content using the Perten Inframatic 8600 Flour Analyzer. Falling number for all barley varieties were determined using the AACC Method 56-81B, AACC Intl., 2000 on a Perten FN 1500 Falling Number Machine. The falling number is related to the level of sprout damage that has occurred in the grain. It is measured by the time it takes, in seconds, for a stirrer to fall through a slurry of flour and water to the bottom of the tube. Falling numbers greater than 350 indicate low enzymatic activity and sound quality sample. A falling number lower than 200 indicates high enzymatic activity and poor quality. Deoxynivalenol (DON) analysis was analyzed using Veratox DON 2/3 Quantitative test from the NEOGEN Corp. This test has a detection range of 0.5 to 5 ppm. Samples with DON values greater than 1 ppm are considered unsuitable for human consumption. Percent germination (germination energy) was determined by incubating 100 seeds in 4.0 ml of water for 72 hours and counting the number of seeds that did not germinate. Each sample was run in duplicate. Grain assortment or plumpness was determined using the Pfeuffer Soritmat using 100g of clean seed, and was determined by the combining the amount of seed remaining on the 2.78mm and 2.38mm sieves.

All data was analyzed using a mixed model analysis where replicates were considered random effects. The LSD procedure was used to separate cultivar means when the F-test was significant ($p< 0.10$).

Variations in yield and quality can occur because of variations in genetics, soil, weather, and other growing conditions. Statistical analysis makes it possible to determine whether a difference among varieties is real or whether it might have occurred due to other variations in the field. At the bottom of each table a LSD value is presented for each variable (e.g. yield). Least Significant Differences at the 10% level of probability are shown. Where the difference between two varieties within a column is equal to or greater than the LSD value at the bottom of the column, you can be sure in 9 out of 10 chances that there is a real difference between the two varieties. In this example, variety A is significantly different from variety C, but not from variety B. The difference between A and B is equal to 725, which is less than the LSD value of 889. This means that these varieties did not differ in yield. The difference between A and C is equal to 1454, which is greater than the LSD value of 889. This means that the yields of these varieties were significantly different from one another. The asterisk indicates that variety B was not significantly lower than the top yielding variety.

Variety	Yield
A	3161
B	3886*
C	**4615***
LSD	**889**

RESULTS

Seasonal precipitation and temperature recorded at a weather station at Borderview Research Farm are shown in Table 3. April, May and June were all colder than normal. April and May had higher precipitation than the 30-year average, while June was somewhat drier. July was both hotter and drier than the 30-year average. From April through July, there was an accumulation of 3261 Growing Degree Days (GDDs), 91 GDDs below the 30-year average.

Table 3. Temperature and precipitation summary for Alburgh, VT, 2019.

Alburgh, VT	April	May	June	July
Average temperature (°F)	42.7	53.3	64.3	73.5
Departure from normal	-2.11	-3.11	-1.46	2.87
Precipitation (inches)	3.65	4.90	3.06	2.34
Departure from normal	0.83	1.45	-0.63	-1.81
Growing Degree Days (32-95°F)	346	660	970	1286
Departure from normal	-38	-96	-44	88

Based on weather data from a Davis Instruments Vantage Pro2 with WeatherLink data logger.
Historical averages are for 30 years of data provided by the NOAA (1981-2010) for Burlington, VT.

Measurements of populations, vigor, disease and pest pressure, heights and lodging were collected through the growing season (Table 4).

The target population was 350 plants per meter square. Most varieties were below the target population, likely due to cold conditions in the early growing season depressing germination. Explorer had the highest population at 385 plants m^{-2}. This was the only variety that had a population at the targeted level. CDC Fraser, Fangio, KW Tinka, LCS Genie, and Sangria also had populations over 300 plants m^{-2}.

Vigor was rated on a scale of 0 (poor vigor) to 9 (lush, healthy plants) at the tillering stage. The highest vigor was Rafale (7.67). The lowest was Esma (3.00).

Fusarium head blight is caused by infection with the *Fusarium graminearum* fungus. Infection can cause reduced yields and poor quality, and can produce a vomitoxin (deoxynivalenol or DON). The FDA limits DON concentrations to 1 ppm for human consumption. There were significant differences between variety in both the incidence and severity of FHB infection. The incidence of infected heads refers to the proportion of barley spikes showing any sign of FHB infection compared to the uninfected spikes in that treatment. The average infected head severity refers to the extent to which infected heads are affected by FHB symptoms. Infection with the fusarium fungus does not always lead to production of the problematic deoxynivalenol compound. While some varieties had over 75% of the barley heads show some evidence of infection with fusarium, DON concentrations for the entire trial were well below the 1 ppm threshold for human consumption (data not shown).

Foliar diseases reduce photosynthetic leaf area, use nutrients, and increase respiration and transpiration within colonized host tissues. Diseased plants may exhibit reduced vigor, growth, and seed fill. Earlier occurrence, greater degree of host susceptibility, and longer duration of conditions favorable for disease development will increase the yield loss. When scouted on 20-Jun, each plot was assessed for several distinct diseases. These individual disease ratings were combined into a single foliar disease rating for statistical analysis. Very little fungal disease was noted. There was no powdery mildew present at the time of scouting, and only eleven individual plants scouted showed any sign of leaf rust.

The variety with the highest disease burden was Pinnacle, with more than 16% of the foliar surface of this variety affected by disease. All plants of this variety were affected with distinctive foliar lesions that did not appear to spread to surrounding plots. Samples were sent to the University of Vermont Plant Diagnostic Clinic but the disease could not be identified. All other varieties had an average of 4% or less of their foliar surface affected by disease, statistically significantly lower than Pinnacle. While quality in this variety did not appear to be adversely impacted, the yield for Pinnacle was less than half of the trial average, significantly lower than all other varieties (Table 5).

Damage from insects and other arthropod pests was not a significant issue in the spring barley trial. Many plants scouted showed no signs of insect damage, and all varieties averaged less than 1% of the foliar surface damaged by pests. Thrips, mites, aphids and cereal leaf beetle presence was noted.

Heights and lodging were measured prior to harvest. Taller plants can be desirable for better competition against weeds; however very tall plants can be prone to lodging. Two varieties that were added to the trial later than the main planting were not harvest at the same time as the others and heights and lodging were not collected for these varieties. Pinnacle was the tallest variety at 35.1 cm. This variety also had the highest degree of lodging (over 90% of the plots were lodged). Esma and LCS Odyssey also experienced a high degree of lodging.

Table 4. 2019 spring barley agronomic characteristics in Alburgh, VT.

Variety	Population	Vigor	FHB Incidence	FHB Severity	Disease	Arthropod Damage	Height	Lodging
	plants m^{-2}	rating (0-9)	%	%	% foliar surface affected	% foliar surface affected	cm	%
2ND32529	299^{a-d}	5.33^{a-f}	27.5^{c-h}	7.4^{a-c}	0.52^{d}	0.18^{bc}	33.0^{a-f}	0.00^{c}
2ND34634	215^{b-d}	3.67^{d-f}	17.6^{d-j}	7.4^{a-c}	1.26^{b-d}	0.42^{bc}	33.4^{a-e}	0.00^{c}
2ND34954	275^{a-d}	3.67^{d-f}	12.9^{g-j}	7.0^{a-d}	2.85^{b-d}	0.38^{bc}	33.7^{a-d}	1.67^{c}
2ND35530	227^{b-d}	7.00^{ab}	19.3^{d-j}	5.2^{b-d}	2.15^{b-d}	0.27^{bc}	32.6^{a-g}	1.67^{c}
2ND35693	227^{b-d}	4.33^{c-f}	14.6^{f-g}	8.3^{a}	1.30^{b-d}	0.42^{bc}	32.3^{a-g}	0.00^{c}
80675-52	256^{a-d}	4.33^{c-f}	17.3^{d-j}	7.0^{a-d}	3.41^{bc}	0.44^{b}	28.1^{g-i}	0.00^{c}
AAC Connect	263^{a-d}	4.33^{c-f}	27.3^{c-h}	8.5^{a}	0.89^{cd}	0.31^{bc}	32.3^{a-g}	0.00^{c}
AAC Synergy	182^{cd}	4.67^{b-f}	9.7^{h-j}	7.0^{a-d}	2.15^{b-d}	0.33^{bc}	30.4^{b-i}	0.00^{c}
Accordine	268^{a-d}	5.00^{b-f}	24.4^{c-i}	7.4^{a-c}	2.07^{b-d}	0.18^{bc}	30.7^{a-i}	0.00^{c}

CDC Fraser	316^{a-c}	6.33^{a-c}	3.5^{j}	4.7^{d}	0.89^{cd}	0.29^{bc}	-	-
Champion	201^{b-d}	5.00^{b-f}	12.3^{g-j}	7.0^{a-d}	1.44^{b-d}	0.42^{bc}	31.0^{a-i}	0.00^{c}
Crescendo	242^{a-d}	4.00^{c-f}	7.7^{h-j}	4.7^{d}	0.89^{cd}	0.55^{ab}	32.8^{a-f}	0.00^{c}
Esma	203^{b-d}	3.00^{f}	36.4^{b-d}	7.0^{a-d}	1.11^{cd}	0.16^{bc}	31.9^{a-h}	16.7^{b}
Explorer	385^{a}	4.67^{b-f}	23.2^{c-j}	7.7^{ab}	1.26^{b-d}	0.49^{b}	28.9^{e-i}	0.00^{c}
Fangio	313^{a-d}	5.33^{a-f}	30.7^{b-g}	7.1^{a-d}	4.00^{b}	0.33^{bc}	31.6^{a-h}	0.00^{c}
Iconic	282^{a-d}	5.00^{b-f}	36.2^{b-e}	8.2^{a}	3.52^{bc}	0.40^{bc}	31.8^{a-h}	1.67^{c}
Klarinette	158^{d}	3.67^{d-f}	49.2^{b}	7.4^{a-c}	2.56^{b-d}	0.22^{bc}	29.1^{d-i}	0.00^{c}
KWS Amadora	251^{a-d}	4.00^{c-f}	9.1^{h-j}	4.8^{cd}	1.91^{b-d}	0.24^{bc}	27.4^{hi}	0.00^{c}
KWS Fantex	194^{b-d}	5.00^{b-f}	12.4^{g-j}	7.0^{a-d}	3.00^{b-d}	0.20^{bc}	29.7^{d-i}	6.67^{b}
KWS Tinka	342^{ab}	5.67^{a-e}	32.3^{b-g}	7.2^{a-d}	0.52^{d}	0.22^{bc}	34.6^{a-c}	1.67^{c}
LCS Genie	311^{a-d}	5.33^{a-f}	15.6^{f-j}	7.0^{a-d}	0.74^{cd}	0.20^{bc}	29.1^{d-i}	0.00^{c}
LCS Odyssey	249^{a-d}	4.67^{b-f}	4.1^{ij}	4.7^{d}	1.48^{b-d}	0.47^{b}	30.4^{b-i}	16.7^{b}
ND Genesis	292^{a-d}	5.00^{b-f}	41.3^{bc}	9.1^{a}	0.67^{cd}	0.93^{a}	28.6^{f-i}	0.00^{c}
Newdale	232^{a-d}	4.33^{c-f}	22.9^{c-j}	7.3^{a-c}	0.89^{cd}	0.13^{bc}	30.0^{c-i}	3.33^{c}
Pinnacle	184^{cd}	4.00^{c-f}	34.1^{b-f}	8.7^{a}	16.0^{a}	0.02^{c}	35.1^{a}	93.3^{a}
Rafale	275^{a-d}	7.67^{a}	77.7^{a}	7.4^{a-c}	1.93^{b-d}	0.20^{bc}	-	-
Sangria	306^{a-d}	6.00^{a-d}	12.1^{g-j}	7.1^{a-d}	1.67^{b-d}	0.33^{bc}	26.8^{i}	0.00^{c}
Tradition	239^{a-d}	3.33^{ef}	77.5^{a}	8.4^{a}	1.81^{b-d}	0.33^{bc}	34.9^{ab}	0.00^{c}
LSD	7.26	2.34	20.8	2.64	2.86	0.41	4.62	11.2
Trial Mean	257	4.80	25.3	7.1	2.2	0.3	31.2	5.12

Within a column, varieties with the same letter did not vary significantly.

*Varieties with an asterisk are not significantly different than the top performer in **bold**.

†Zero (0) indicates no damage and nine (9) indicates that 100% of the plot was severely affected.

Spring Barley Yield and Quality

Yield and quality varied significantly between varieties of spring barley (Table 5, Figure 1).

Table 5. Harvest and quality for 28 spring barley varieties trialed in Alburgh, VT, 2019.

Variety	Yield @ 13.5% moisture content	Harvest moisture	Test Weight	Crude Protein @ 12% moisture content	Falling Number	Germination	Plumpness
	lbs ac^{-1}	%	lbs bu^{-1}	%	seconds	%	%
2ND32529	4242$^{a-d\dagger}$	18.1^{c-g}	48.1^{a-d}	9.3^{h}	295^{ij}	96.7^{a-f}	97.6^{a-e}
2ND34634	3855^{b-f}	19.1^{b-f}	43.6^{g-j}	11.1^{c-h}	272^{jk}	96.7^{a-f}	97.7^{a-d}
2ND34954	4253^{a-d}	20.8^{a-d}	47.0^{a-f}	11.3^{c-h}	331^{c-i}	95.3^{b-g}	95.4^{h}
2ND35530	5397^{a}	21.5^{a-c}	43.5^{g-j}	11.1^{c-h}	308^{h-j}	90.0^{h}	95.6^{f-h}
2ND35693	4815^{ab}	18.5^{c-g}	49.8^{a}	11.2^{c-h}	335^{c-h}	95.0^{b-g}	96.3^{b-h}
80675-52	1610^{ij}	22.4^{ab}	44.0^{f-j}	11.1^{c-h}	332^{c-h}	95.3^{b-g}	95.6^{gh}
AAC Connect	3590^{b-h}	15.0^{gh}	45.4^{d-h}	11.4^{c-h}	253^{kl}	97.7^{a-e}	95.7^{f-h}
AAC Synergy	4076^{b-e}	17.2^{d-g}	47.3^{a-e}	11.3^{c-h}	316^{g-i}	98.7^{ab}	96.8^{a-h}
Accordine	3039^{d-h}	21.4^{a-c}	44.2^{f-j}	15.2^{a}	320^{f-i}	94.3^{d-g}	95.6^{gh}
CDC Fraser	4266^{a-d}	15.6^{f-h}	45.3^{d-i}	13.6^{a-c}	234^{l}	97.3^{a-e}	95.8^{e-h}
Champion	3540^{b-h}	14.8^{gh}	48.7^{a-c}	13.0^{a-e}	368^{b-c}	92.3^{gh}	97.9^{a-c}
Crescendo	2437^{hi}	20.5^{a-d}	42.8^{h-j}	11.2^{c-h}	357^{b-e}	95.0^{b-g}	98.2^{a}
Esma	4433^{a-c}	16.5^{e-h}	48.1^{a-d}	12.2^{b-f}	181^{m}	97.0^{a-e}	95.8^{e-h}
Explorer	4469^{a-c}	15.6^{f-h}	48.8^{ab}	14.3^{ab}	316^{g-i}	97.7^{a-e}	98.0^{ab}
Fangio	2790^{f-i}	23.4^{a}	44.1^{f-j}	11.0^{e-h}	219^{l}	93.0^{f-h}	96.0^{c-h}
Iconic	2748^{f-i}	19.2^{b-f}	42.1^{j}	11.2^{c-h}	337^{c-h}	92.7^{gh}	96.9^{a-h}
Klarinette	3052^{d-h}	18.3^{c-g}	46.2^{b-g}	12.0^{b-f}	358^{b-d}	97.0^{a-e}	96.8^{a-h}
KWS Amadora	2547^{g-i}	17.2^{d-g}	44.4^{e-j}	10.4^{f-h}	234^{l}	98.0^{a-d}	96.5^{a-h}
KWS Fantex	3808^{b-g}	17.6^{d-g}	44.0^{f-j}	11.4^{c-h}	361^{b-c}	96.7^{a-f}	95.7^{f-h}
KWS Tinka	4452^{a-c}	19.1^{b-f}	47.4^{a-e}	12.0^{b-f}	317^{g-i}	94.7^{c-g}	97.5^{a-f}
LCS Genie	3474^{c-h}	19.5^{b-e}	46.5^{b-g}	11.5^{c-h}	418^{a}	95.0^{b-g}	96.6^{a-h}
LCS Odyssey	2806^{e-i}	17.3^{d-g}	42.2^{ij}	11.2^{c-h}	345^{c-h}	94.0^{e-g}	97.4^{a-g}
ND Genesis	3602^{b-h}	19.7^{a-e}	46.4^{b-g}	9.4^{gh}	308^{h-j}	98.3^{a-c}	95.7^{f-h}
Newdale	3473^{c-h}	15.7^{f-h}	47.5^{a-e}	12.3^{b-f}	355^{b-f}	95.3^{b-g}	93.0^{i}
Pinnacle	1117^{j}	15.1^{gh}	45.6^{c-h}	10.4^{gh}	350^{c-g}	97.3^{a-e}	91.2^{i}
Rafale	4761^{ab}	12.7^{h}	45.8^{b-h}	13.6^{a-d}	391^{a-b}	99.7^{a}	95.8^{e-h}
Sangria	3056^{d-h}	17.7^{c-g}	47.1^{a-f}	11.8^{b-g}	321^{e-i}	95.7^{b-g}	95.9^{d-h}
Tradition	3795^{b-g}	14.9^{gh}	43.6^{g-j}	12.7^{a-f}	324^{d-i}	100.0^{a}	96.5^{a-h}
LSD (p=0.10)	1283	3.77	3.15	2.49	37.1	3.97	1.84
Trial Mean	3553	18.01	45.7	11.7	316.3	95.9	96.2

†Within a column, varieties with the same letter did not vary significantly.

Yields were exceptionably variable in the variety trial, ranging from a low of 1117 lbs ac^{-1} (Pinnacle) to a high of 5794 lbs ac^{-1} (2ND35530). 2ND32529, 2ND34954, 2ND35693, AAC Synergy, CDC Fraser, Esma, Explorer, KWS Tinka, and Rafale all had yields over two tons ac^{-1}.

2ND35693 had the highest test weight at 49.8 lbs bu^{-1}. 2ND32529, Champion, Esma, and Explorer all had test weights meeting the industry standard of 48 lbs bu^{-1}.

The industry standard for crude protein for malting barley is between 9%-11% for optimal malting quality. Most of the varieties grown in 2019 fell within the industry standard. None were below 9% crude protein. Accordine, CDC Fraser, Champion, Esma, Explorer, Klarinette, KWS Tinka, Newdale, Rafale, and Tradition all had crude protein levels at or above 12%.

Falling number is an indicator of enzymatic activity and/or sprouting damage. Falling number was generally good across the trial. Esma was the only variety with a falling number less than 200, indicating low enzymatic activity in this variety.

Most varieties met the industry standard of 95% for germination. 2ND35530, Accordine, Champion, Fangio, Iconic, KWS Tinka, and LCS Odyssey had germination between 90% and 95%. All varieties were above industry standards for plumpness (>80% for a two-row and >70% for a six row barley).

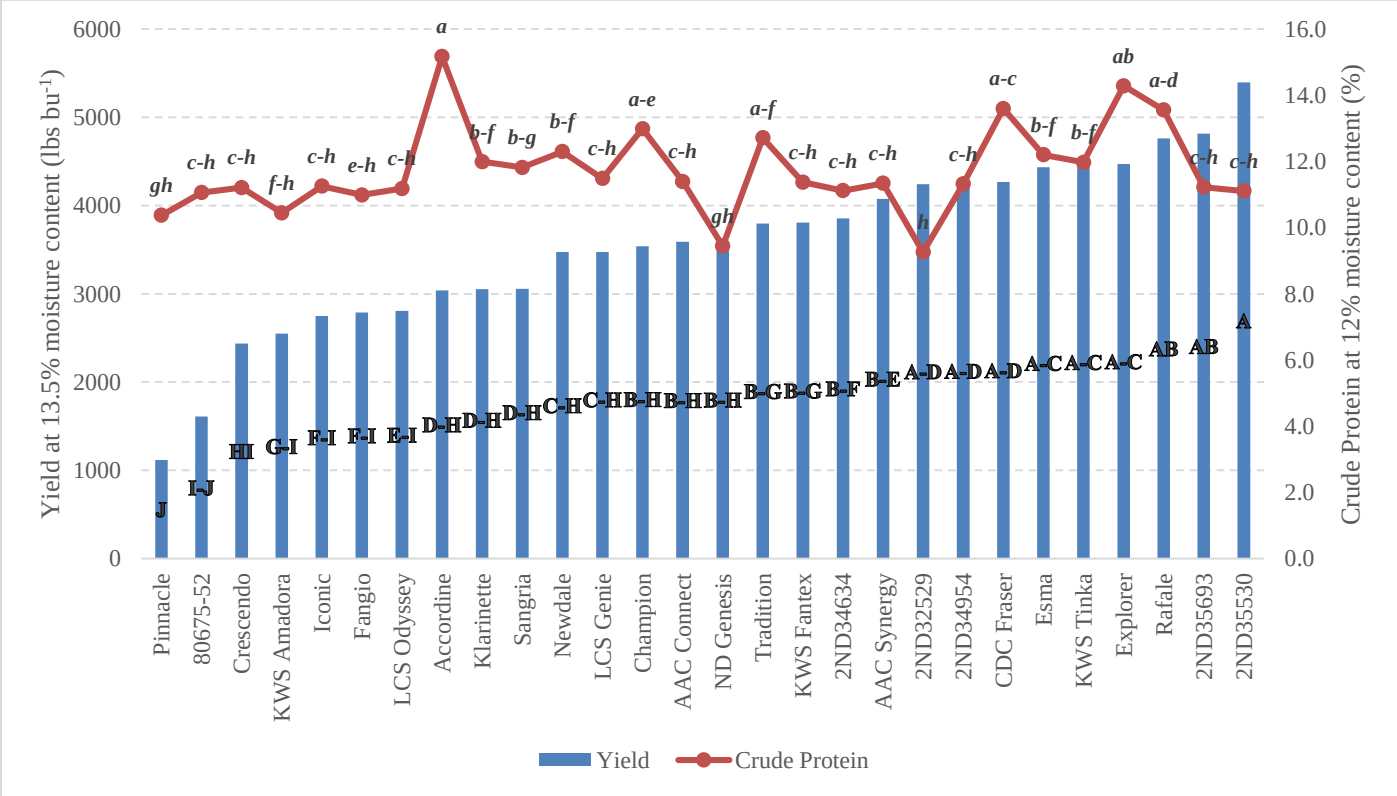

Figure 1. Yield and crude protein for the spring barley varieties trialed in Alburgh, VT, 2019.
Varieties with the same capital letter did not differ significantly by yield. Varieties with the same lower case letter did not differ significanlty by crude protein.

DISCUSSION

Despite a challenging beginning to the growing season with cold weather delaying planting and suppressing germination, 2019 was overall a fairly good year for growing spring barley. Quality parameters were very good for most varieties. Yields were extremely variable, with some very high yields. The average yield for the trial was 3553 lbs ac^{-1}, higher than the grand mean yield from 2011-2017 spring barley variety trials at Borderview Research Farm of 2289 lbs ac^{-1}. Some varieties had exceptional yields. Insect and bird damage were minimal.

In terms of quality parameters, the test weight, crude protein, plumpness, germination, DON concentrations, and falling number were all very good, with almost all barley varieties meeting or exceeding industry standards.

There were no varieties that across the board out-performed the others. All varieties that were statistically similar as high yielding varieties were in the highest category for some quality parameters but not for others. It is important to note that these results represent only one year of data. As farmers make variety selections, they should make sure to evaluate data from test sites that are as similar to their own region as possible. It is our intention to continue this research in 2020.

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